Part I

The State of the Transportation System

TRAVEL, THE MOVEMENT OF FREIGHT, AND THE TRANSPORTATION SYSTEM

AN ENORMOUS AND DIVERSIFIED TRANSPORTATION SYSTEM SERVES 260 MILLION PEOPLE, 6 MILLION BUSINESS ESTABLISHMENTS, AND 87,000 GOVERNMENTAL UNITS SCATTERED OVER THE 3.7 MILLION SQUARE MILES OF THE UNITED STATES. IN 1994, THE SYSTEM CARRIED MORE THAN 4.2 TRILLION PASSENGER-MILES OF TRAVEL AND 3.7 TRILLION TON-MILES OF FREIGHT. (USDOT BTS 1995)

Geography partly explains the scale of the U.S. transportation system. For example, the two largest metropolitan regions—New York and Los Angeles—are 2,800 miles apart by the most direct Interstate highway route. Our nation's capital is 4,800 air-miles away from the most distant state capital in Honolulu, Hawaii. One National Park Service ranger travels more than 4,400 miles by road each spring and fall between seasonal assignments in Denali National Park, Alaska, and Everglades National Park, Florida.

The quantity of passenger travel and goods movement continues to increase faster than the U.S. population

To bridge such distances, the United States developed an extensive interconnected network of public roads, railroads, pipelines, public transit systems, commercially navigable waterways and ports, and the airports and other facilities that make up the aviation system (see table 1-1). This network is supported by a multifaceted transportation industry. When broadly defined, it

Table 1-1: Major Elements of the Transportation System, 1994

Mode	Major defining elements	Components
Highways[a]	Public roads and streets; automobiles, vans, trucks, motorcycles, and buses (except local transit buses) operated by transportation companies, other businesses, governments, and households; garages, truck terminals, and other facilities for motor vehicles	*Roads* 45,826 miles of Interstate highway 110,673 miles of other proposed National Highway System roads 3,764,422 miles of other roads *Vehicles and use* 134 million cars driven 1.6 trillion miles 57 million light trucks driven 0.6 trillion miles 6.3 million freight trucks driven 0.2 trillion miles, carrying 877 billion ton-miles of freight 670,000 buses driven 6.4 billion miles
Air	Airways and airports; airplanes, helicopters, and other flying craft for carrying passengers and cargo	*Public use airports* 5,474 airports *Airports serving large certificated carriers*[b] 28 large hubs (71 airports), 372 million enplaned passengers 33 medium hubs (57 airports), 89 million enplaned passengers 61 small hubs (75 airports), 34 million enplaned passengers 530 nonhubs (562 airports), 13 million enplaned passengers *Aircraft* 5,221 certificated air carrier aircraft, 4.4 billion miles flown *Passenger and freight companies* 82 carriers with 489 million revenue passenger-enplanements and 11.7 billion ton-miles of freight
Rail[c]	Freight railroads and Amtrak	*Railroads* 122,492 miles of major (Class I) 19,842 miles of regional 25,599 miles of local *Equipment (Class I)* 1.2 million freight cars 18,505 locomotives *Freight railroad firms* Class I: 12 companies, 189,962 employees, 1.2 trillion ton-miles of freight carried Regional: 32 companies, 10,701 employees Local: 487 companies, 13,070 employees *Passenger (Amtrak)* 24,991 employees, 1,874 passenger cars, 338 locomotives, 21.2 million passengers carried
Transit[d]	Commuter trains, heavy-rail (rapid-rail) and light-rail (streetcar) transit systems, and local transit buses	*Number of systems* 508 local public transit operators, 291,749 employees *Vehicles* 44,041 buses, 17.4 billion passenger-miles 8,960 rapid and light railcars, 10.9 billion passenger-miles 4,214 commuter railcars, 6.9 billion passenger-miles 92 ferryboats, 241 million passenger-miles 11,262 demand response vehicles, 389 million passenger-miles

TABLE 1-1 (CONT'D): MAJOR ELEMENTS OF THE TRANSPORTATION SYSTEM, 1994

Mode	Major defining elements	Components
Water[e]	Navigable rivers, canals, the Great Lakes, St. Lawrence Seaway, Intercoastal Waterway, ocean shipping channels; ports; commercial ships and barges, fishing vessels, and recreational boats	*U.S.-flag domestic fleet* Great Lakes: 694 vessels, 109.8 million short tons Inland: 31,340 vessels, 681.7 million short tons Ocean: 7,074 vessels, 276.7 million short tons *Ports* Great Lakes: 507 berths Inland: 1,789 terminals Ocean: 2,666 berths
Pipeline[f]	Crude oil, petroleum product, and gas trunk lines	*Oil* Crude lines: 112,990 miles of pipe, 344.5 billion ton-miles Product lines: 86,033 miles of pipe, 248 billion ton-miles, 145 companies with 18,400 employees *Gas* Transmission: 272,000 miles of pipe, 19.3 trillion cubic feet, 135 companies with 195,700 employees

[a] U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1994* (Washington, DC: 1995).
[b] U.S. Department of Transportation, Bureau of Transportation Statistics and Federal Aviation Administration, *Airport Activity Statistics of Certificated Route Air Carriers, 1994* (Washington, DC: 1996).
[c] All numbers from American Association of Railroads, *Railroad Facts* (Washington, DC: March 1995), except Amtrak figures from National Railroad Passenger Corp., *1994 Annual Report* (Washington, DC: 1995).
[d] All numbers are for 1993. U.S. Department of Transportation, Federal Transit Administration, *National Transit Summaries and Trends for the 1993 National Transit Database Section 15 Report Year* (Washington, DC: 1995).
[e] Data for 1993 from U.S. Department of Transportation, Federal Highway Administration, Federal Transit Administration, and Maritime Administration, *1995 Status of the Nation's Surface Transportation System: Condition and Performance* (Washington, DC: October 1995), pp. 213, 219–220, 236.
[f] Data for 1993. Miles of gas distribution pipeline not included.
SOURCE: Unless otherwise noted, U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 1996* (Washington, DC: November 1995).

includes for-hire transportation services (such as taxicab companies and worldwide parcel express carriers), and in-house transportation providers (such as the trucking fleet of a grocery chain); it also encompasses construction and maintenance companies, vehicle manufacturers, transportation facility operators, gas stations, travel agents and freight forwarders, transportation equipment sales and leasing firms, and agencies that administer transportation programs.

This chapter describes the passenger and freight movements that vie for space on the nation's transportation system, and summarizes the physical condition and performance of the system as it stretches to meet the demand. Chapter 2 discusses the economic performance of transportation followed in later chapters by an examination of the unintended consequences of transportation such as safety problems, oil import dependence, and environmental impacts.

Passenger Travel

People in the United States travel more now than ever before. Annual passenger-miles per person, including commercial travel, rose from about 11,400 in 1970 to 16,800 in 1994. Passenger-miles traveled increased 89 percent between 1970 and 1994 for an average annual growth rate of 2.7 percent. (USDOT BTS 1995) According to the Nationwide Personal Transportation Survey (NPTS), the annual number of trips per person increased from 736 in 1969 to 1,042 in 1990. (USDOT FHWA 1993a, table 4-1; USDOT BTS 1995) Over this period, trip lengths declined by 4 percent, but in more recent years (1983 to 1990) the average trip length increased from 8.68 miles to 9.45 miles. (USDOT FHWA 1993a)

Despite the recent increase in trip length and growth in domestic and international air travel, local travel (defined as trips under 75 miles) still accounted for 69 percent of passenger-miles. Most trips were made for family and personal business reasons (41.5 percent), followed by pleasure (24.8 percent), and work-related travel (21.6 percent). The rest were predominantly for civic, educational, and religious reasons. (USDOT FHWA 1993a, table 4.10) The pattern of local and nonlocal travel varies by mode of transportation. About 98 percent of passenger-miles by rail or subway are for trips under 75 miles in length. Three-quarters of passenger-miles made by car are local.

Excluding commercial driving (e.g., miles driven by cab drivers, truck drivers, and delivery people), long-distance travel accounted for 890 billion passenger-miles of travel in 1990 (USDOT FHWA 1993a, table 2.3), most of which (660 billion miles) were for pleasure, particularly for visiting friends and vacationing. About 15 percent (129 billion miles) were for family and personal business, including shopping and doctor or dentist visits. Only 9 percent (81 billion miles) were for long-distance commuting or business trips. More detailed and up-to-date information on long-distance travel will soon be available from the American Travel Survey (ATS), which was conducted by the Bureau of the Census for the Bureau of Transportation Statistics (BTS). The Census Bureau surveyed 80,000 households for the ATS and will report on trips of more than 75 miles in length.

Globalization of the economy has resulted in a marked increase in passenger travel to and from the United States for both business and pleasure. Foreign vacations have become more affordable; international trade and investment have also encouraged international travel. The number of air passenger arrivals in the United States from foreign countries (regardless of the nationality of the passenger) increased from about 12.6 million in 1975 to 44 million in 1994. The top countries of embarkation are Canada, the United Kingdom, Japan, Mexico, Germany, and France. (USDOT FHWA 1993a)

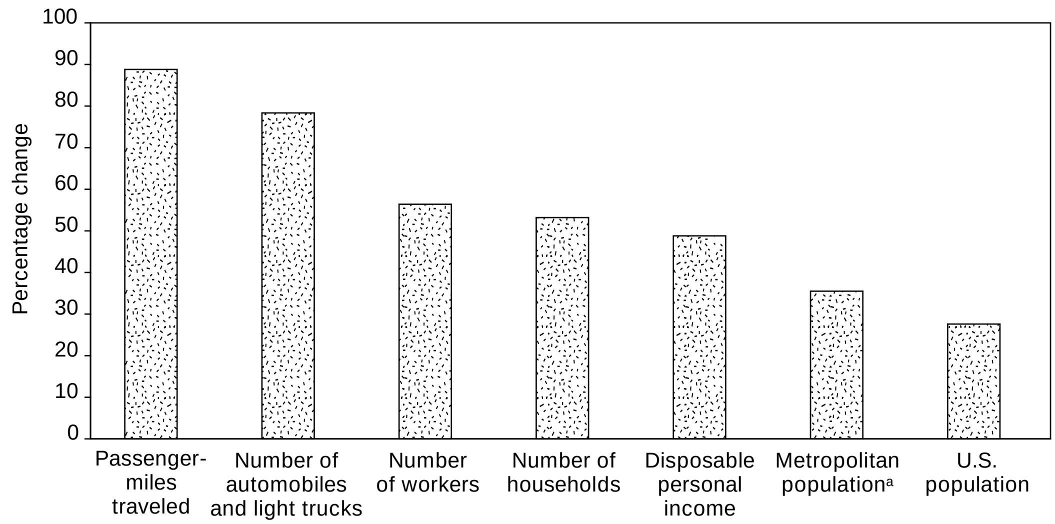
Many people also enter the United States by land. In 1994, nearly 12 million Canadian residents—80 percent of all arrivals from Canada—visited the United States for one or more nights by non-air modes of transportation, predominantly by automobile. (Statistics Canada 1995) In the same year, Mexicans visiting the United States for more than one night numbered 11 million. (Secretaria de Turism 1995) The transportation mode used by Mexican visitors cannot be estimated with the available data.

► Sources of Travel Growth

Several factors have contributed to the growth in passenger-miles traveled, including population, job, and income growth, access to motor vehicles, and residential and job location changes (see figure 1-1). The U.S. population grew by 56 million people between 1970 and 1994 reaching 260 million people in 1994. Natural increase (the difference between births and deaths) accounted for 70 percent of the growth; immigrants, who numbered nearly 17 million over the period, accounted for 30 percent of the increase in population. Immigration has a greater near-term impact on transportation because most immigrants are adults who use the transportation systems more than children.

Employment is another factor that impacts passenger travel. Between 1970 and 1994, the civilian labor force increased more than twice as fast as the population, growing from 83 million to 131 million. The two main reasons for the worker boom are that the baby boom generation reached labor force age, and women joined the labor force in great numbers. The number of women in the civilian labor force nearly doubled, rising from 32 million in 1970 to 60 million in

FIGURE 1-1: CHANGE IN PASSENGER-MILES TRAVELED AND FACTORS AFFECTING TRAVEL DEMAND, 1970–94



[a]1970–1990. Figures for 1990 are calculated using 1980 metropolitan area definitions and therefore differ from figures based on current U.S. census definitions.

SOURCES: Adapted from U.S. Department of Transportation, Federal Highway Administration, Federal Transit Administration, and Maritime Administration, *1995 Status of the Nation's Surface Transportation System: Condition and Performance* (Washington, DC: Oct. 27, 1995); U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States, 1995* (Washington, DC: U.S. Government Printing Office, 1995); and various sources as compiled and cited in U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 1996* (Washington, DC: November 1995).

1994. Women now constitute 46 percent of the U.S. workforce, up from 38 percent in 1970.

Growth in passenger travel is also related to recreation and other household activities. Such travel is more closely related to the number of households than to population size. The number of households grew more rapidly than the population because households became smaller. While the population grew 28 percent between 1970 and 1994, the number of households grew 53 percent. In 1994, the average household comprised 2.67 people, down from 3.14 in 1970.

Another factor contributing to the growth in passenger-miles is the increase in motor vehicles and licensed drivers. The number of automobiles and light trucks grew from 107 million in 1970 to 191 million in 1994, and the number of vehicles owned or available to households on a regular basis (including cars, trucks and vans, recreational vehicles, motorcycles and mopeds) rose from 1.2 vehicles in 1969 to 1.8 in 1990.[1] Between 1969 and 1990, the number of licensed drivers increased by almost 60 percent. (USDOT FHWA FTA MARAD 1995, 12)

Increases in the number of vehicles are partly related to income growth. When people have more money to spend, they spend more on transportation, including personal vehicles. Rising income also generates demand for long-distance travel, especially international travel.

Disposable personal income per capita rose from $9,875 in 1970 to $14,696 in 1994 (in constant 1987 dollars). (USDOC Bureau of the

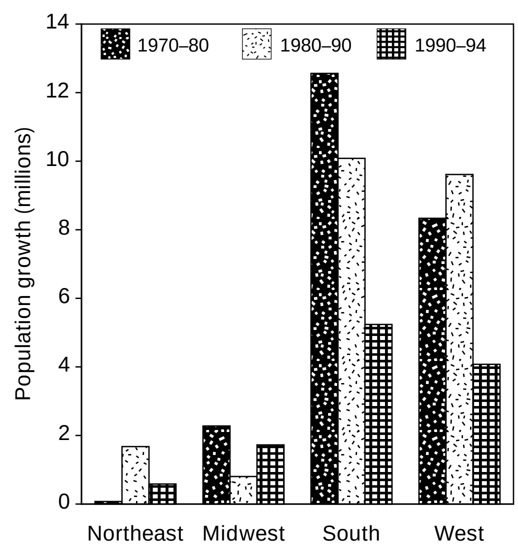
[1] The 1969 NPTS did not include pickup and other light trucks as household vehicles, and thus the number of household vehicles are underestimated somewhat compared with the 1990 survey. Chapter 5 discusses problems with the data on the number of vehicles. (USDOT FHWA 1993a, 3-37)

Census 1995, 456) Median household income, however, remained almost constant, partly because of the decrease in household size and partly because of the changing income distribution among income groups. (In constant 1993 dollars, median household income was $30,558 in 1970 and $31,242 in 1993.) A comparison of income and car prices shows that it now takes longer for a household to earn the money needed to purchase an average-priced new car: about 26 weeks in 1993 as opposed to 19 weeks in 1969 (see chapter 2, figure 2 in box 2-1). Despite the fact that cars are now more expensive in real terms than they were 25 years ago, the number of cars per capita and the number of cars per household has grown.

Growth in travel has not been evenly distributed across the country. Population in the South and West grew much faster than the Northeast and Midwest, resulting in major regional differences in transportation demand (see figure 1-2). Between 1970 and 1994, the South grew by 28 million people and the West by 22 million. By contrast, the Midwest grew by only 5 million and the Northeast by only 2 million.

Moreover, a much larger percentage of the U.S. population now lives in metropolitan areas than in 1970. Metropolitan populations are, however, dispersed over wider areas than before, contributing to travel growth. (USDOT FHWA FTA MARAD 1995, 43) According to decennial census data, metropolitan areas grew from 140 million in 1970 to 189 million in 1990.[2] Between 1970 and 1990, central city areas grew from about 64 million to 72 million people, and suburbs grew from 76 million to 117 million people. Between 1980 and 1990, however, the population of central cities declined by about 500,000 while suburbs grew by 17.5 million. The suburban share of the metropolitan population was 62 percent in 1990, up from 54 percent in 1970. The share of jobs in the suburbs also increased: 42 percent of jobs in 1990 were in the suburbs, up from 37 percent in 1980.

FIGURE 1-2: POPULATION GROWTH BY REGION, 1970–94



SOURCE: U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States, 1995* (Washington, DC: 1995), table 27.

While these factors will most likely contribute to continued growth in passenger travel in the future, the rate of growth may taper off (see summary in table 1-2). Demographic changes could affect trends in local and intercity travel. For example, the age cohort with the highest propensity to travel (ages 40 to 49) is now entirely composed of baby boomers. (USDOT FHWA 1993a, 4-11) They are likely to travel more and travel longer distances, particularly abroad (foreign travel increases with income). Long-distance travel is also likely to be affected by such things as the number of family members attending out-of-town colleges. The number of 18- to 24-year-olds, which declined from the early 1980s to the mid-1990s, is expected to rise from the recent low of 24 million

[2] Figures for 1990 are calculated using 1980 metropolitan area definitions and therefore differ from figures based on current U.S. census definitions.

TABLE 1-2: POSSIBLE CONTRIBUTIONS TO FUTURE TRANSPORTATION DEMAND

Factor	Comments
Forces of stability	
Population growth	Slow overall growth (approximately 1 percent annually), but higher than most western European countries.
Household formation	Leveling off.
Migration patterns	Slowing of internal migration to growth areas of South and West.
Employment	Slower growth in the labor force.
Women's labor force participation	Slower growth as it approaches that of men's participation.
Vehicle availability	Reaching saturation levels.
Forces of change	
Immigration	Possibly large, with immediate impact on transportation systems.
Aging	Baby boomers coming into prime traveling age: large impact on long-distance domestic and international travel.
Residential and job dispersal	Continued dispersal will lead to more travel, particularly single-occupancy vehicles.
Income	Slow increases in income, but large increases in travel by the low-income population.
Women's travel	Increasing travel by women, not related to having a driver's license or labor force participation.
Work-at-home/telecommuting	Uncertain.

people to 30 million people by 2010.[3] (USDOC Bureau of the Census 1995, table 24)

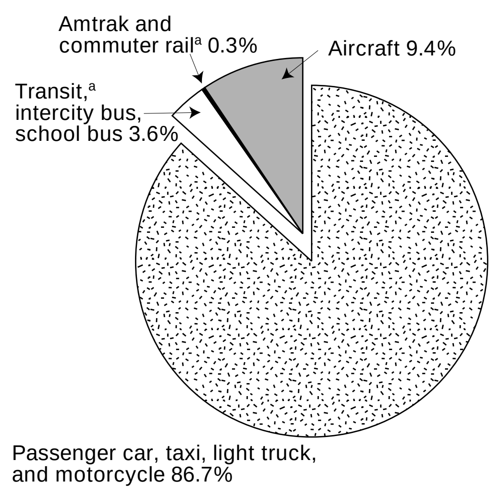
► Patterns of Travel

In 1994, 87 percent of the passenger-miles traveled in the United States were in automobiles and light trucks, including pickups, sport utility vehicles, and minivans (see figure 1-3). Much of the rest, 9 percent, was by air. (USDOT BTS 1995) In 1993, passenger travel on transit, was less than 1 percent of the total, or 36 billion passenger-miles. (USDOT FTA 1995)

Highway Vehicle Travel

Although passenger-miles in automobiles and light trucks increased by 80 percent over the past quarter century, the share of passenger-miles made by cars and light trucks decreased from 90 percent in 1970 to 87 percent in 1994. The cause is the great increase in air travel—from 5 percent of all passenger-miles in 1970 to 9 percent in 1994. In the category of highway travel, trav-

FIGURE 1-3: PASSENGER-MILES BY MODE, 1994



[a]Data are for 1993.

NOTE: Excludes heavy trucks.

SOURCE: Eno Transportation Foundation and other sources cited in U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 1996* (Washington, DC: November 1995).

[3] Projections are middle series.

el in light trucks (pickups, minivans, and sport-utility vehicles) increased most rapidly over this period (by 361 percent). Light trucks accounted for 8.5 percent of all passenger-miles in 1970, but 21 percent in 1994. (USDOT BTS 1995)

Highway vehicles-miles traveled (vmt) by all vehicles was 2.4 trillion miles in 1994, up from 1.1 trillion in 1970.[4] Automobiles and light trucks traveled 92 percent of the vmt in 1994, with most of the rest traveled by trucks, which is almost unchanged from 1970. Figure 1-4 shows the variation in vmt by state.

Air Travel

Aviation is key to intercity and international travel (see appendix A). Over the past 25 years, total air passenger-miles more than tripled—from 108 billion in 1970 to 388 billion in 1994 (measured by domestic revenue passenger-miles). By 1994, annual domestic per capita travel by air reached 1,492 miles, up from 532 miles in 1970. (USDOT BTS 1995)

Enplanements take place primarily at the 28 large airport hubs, which are geographic areas boarding more than 1 percent of the total air passengers in a year. A hub can include more than one airport. (For example, the Washington, DC, hub includes Dulles and National Airports.) Large hubs enplaned 73 percent of passengers in 1994. As can be seen in figure 1-5, the largest hubs are Chicago, Dallas-Fort Worth, Atlanta, Los Angeles, and New York. The most growth (in percent) occurred in Las Vegas, rising from 5 million to 12 million enplanements, Orlando (5 million to 9 million), Salt Lake (4 million to 8 million), Phoenix (7 million to 12 million), and Charlotte (5 million to 9 million).

General aviation passenger-miles (including corporate, air taxi, sightseeing, and instructional aircraft) grew by only 7 percent between 1970 and 1994, now accounting for approximately 9.7 billion miles. (USDOT BTS 1995)

Travel by Transit, Trains, and Intercity Buses

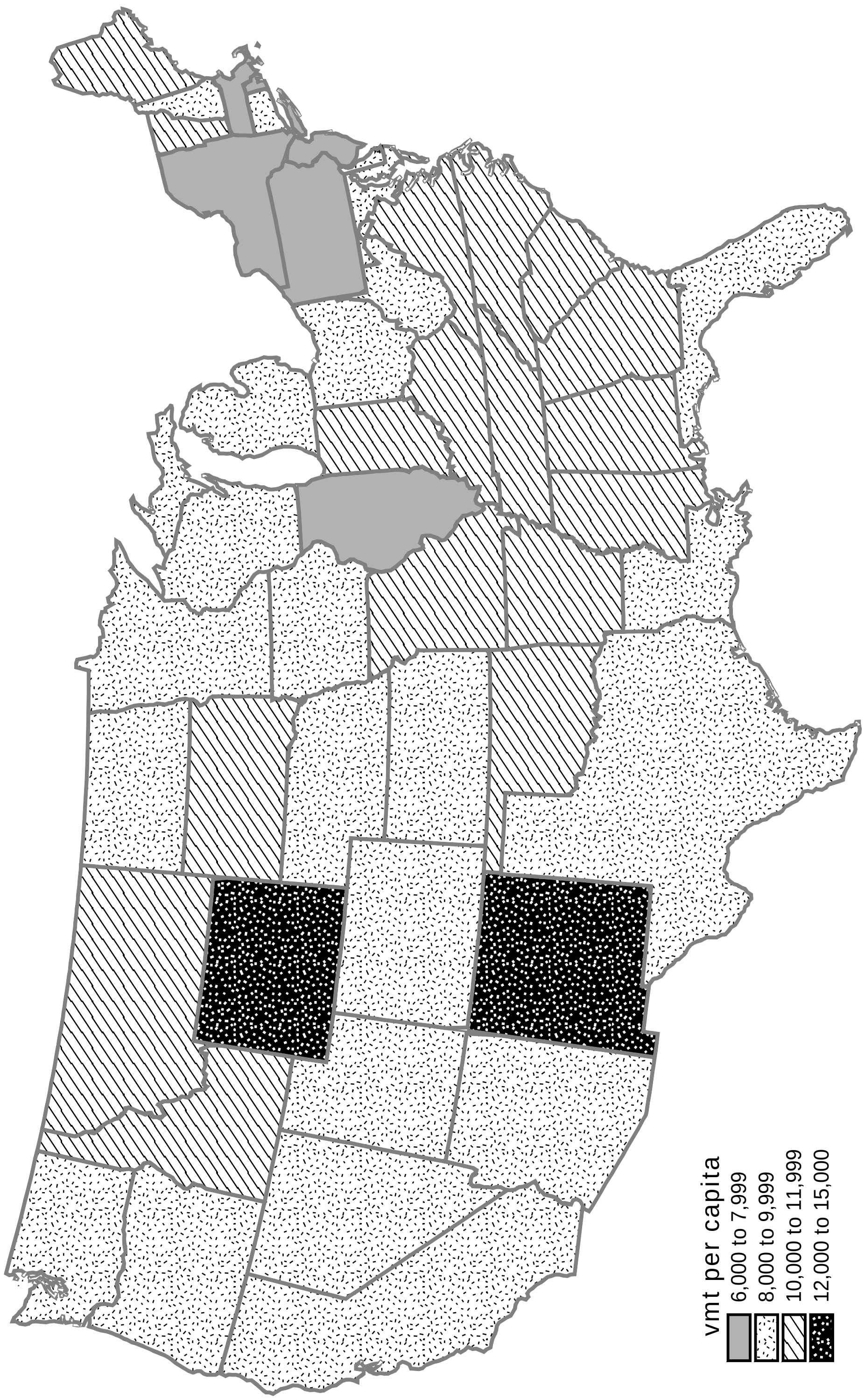
Transit (including buses, heavy rail, commuter rail, light rail, and demand response transit), accounted for 36 billion passenger-miles in 1993. Transit use is split almost equally between rail and nonrail systems with 17.8 billion passenger-miles on rail systems in 1993 and 18.4 billion on nonrail (mostly bus) systems. (USDOT FTA 1995, 71) Passenger travel on transit increased in the 1970s from approximately 6.5 billion unlinked trips at the nadir in 1972 to 8.2 billion unlinked trips in 1980, and remained at that level during the 1980s. Recently, unlinked passenger trips and passenger-miles on transit decreased. Passenger-miles fell from 38.5 billion on 8.1 billion unlinked trips in 1989 to 36.2 billion passenger-miles on 7.4 billion trips in 1993. As a result of growth in other modes, the fraction of passenger-miles on transit declined from approximately 1.4 percent in 1970 to 0.9 percent in 1994. Most transit passenger-miles are made in large metropolitan areas that have large transit agencies. Indeed, 79 percent of passenger-miles are made in the transit systems of the 30 largest agencies. Figure 1-6 shows rail and bus system passenger-miles traveled for the nation's urban areas in 1993.

Passenger-miles on Amtrak have increased from about 3 billion in 1972, Amtrak's first full year of operation, to about 6 billion in 1994. (AAR 1980 and 1995b) Thus, intercity train travel on Amtrak accounted for one-tenth of 1 percent of total passenger travel in 1994. Amtrak carried 21.8 million passengers in 1994 compared with 22.1 in 1993. (Amtrak 1995, 20)

In both 1970 and 1994, intercity buses accounted for 25.3 billion passenger-miles. In the intervening years, passenger-miles increased to 27.7 billion and dropped to 22.6 billion in the

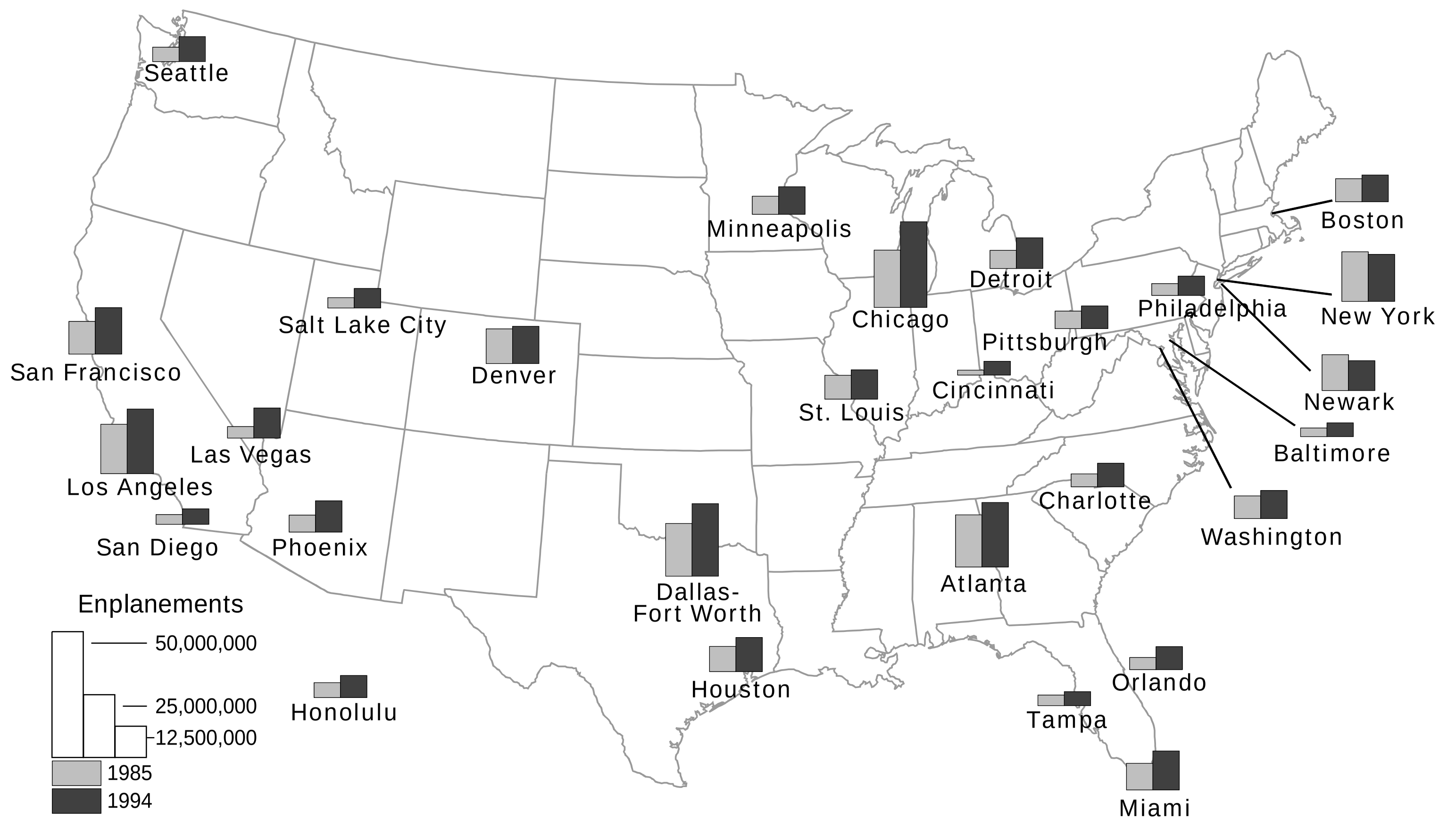
[4] Chapter 5 discusses problems with vmt data.

FIGURE 1-4: VEHICLE-MILES TRAVELED PER CAPITA, 1994



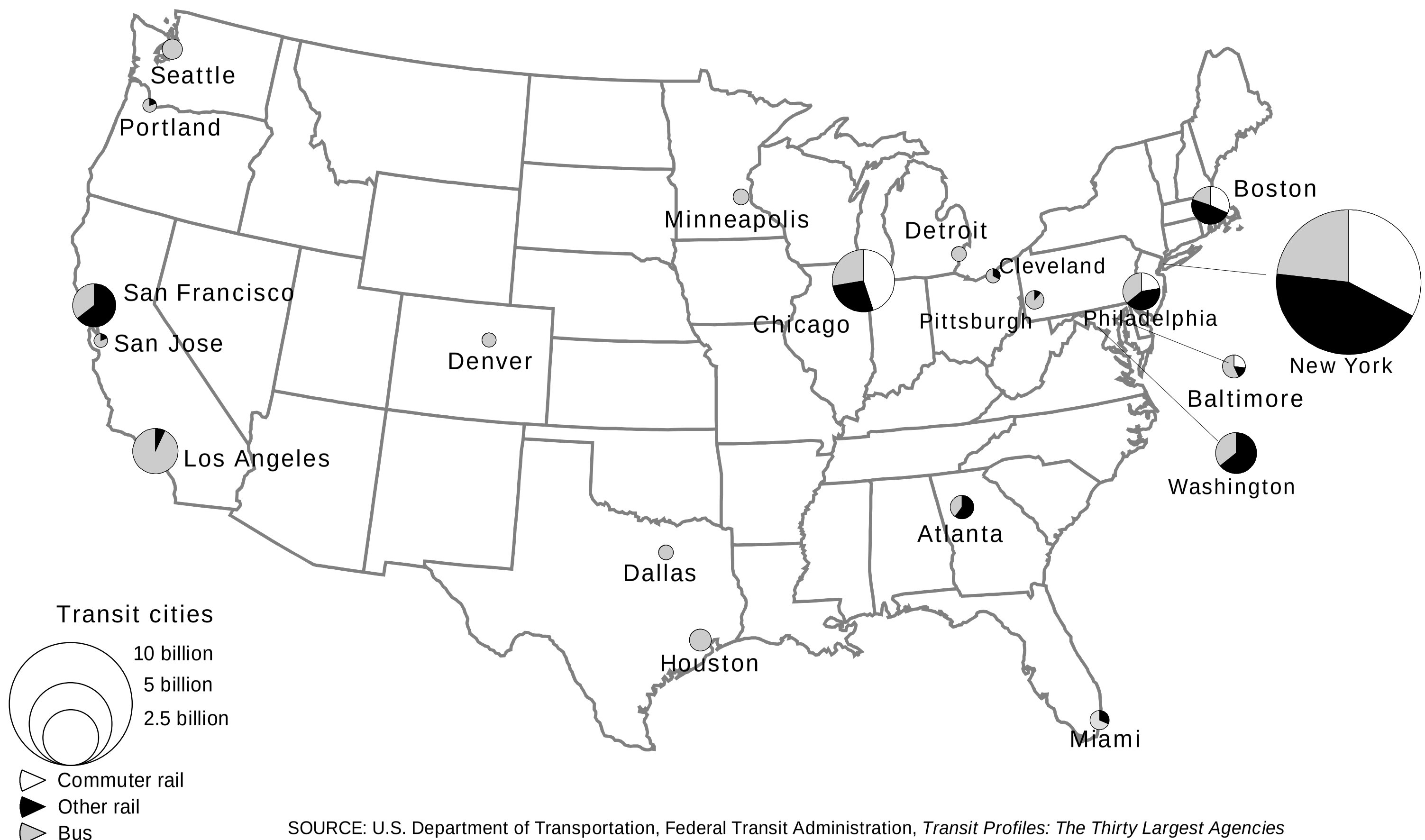
SOURCE: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1994* (Washington, DC: 1995), p. V-116.

FIGURE 1-5: ENPLANEMENTS AT MAJOR HUBS, 1985 AND 1994



SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, Office of Airline Information data.

FIGURE 1-6: TRANSIT PASSENGER-MILES BY CITY, 1993



SOURCE: U.S. Department of Transportation, Federal Transit Administration, *Transit Profiles: The Thirty Largest Agencies* (Washington, DC: December 1994).

early 1990s. (Eno Transportation Foundation 1995, 47)

Since 1980, the earliest date for which data are available, passenger-miles on school buses doubled from 41 billion to 85 billion in 1994. (National Safety Council various years)

Water Transportation

Passenger transportation by water is principally for general use, including commuting and recreation. Transit ferryboat operations are the most important component of general use water transportation. The 14 ferryboat agencies included in the National Transit Database provided 240 million passenger-miles of service in 1993, down from over 300 million passenger-miles in 1980. In 1993, more than 80 percent of ferry passenger-miles were provided in Seattle and New York. (USDOT FTA 1995, 32)

Recreational water transportation comprises cruises and recreational boating, both of which have grown rapidly since 1980. According to the Cruise Lines Industry Association, between 1980 and 1993, the North American cruise market's annual growth averaged 9.2 percent. In 1994, 4.8 million passengers, 85 percent of them U.S. citizens, sailed overnight from U.S. and Canadian ports. (Krapf 1994) The top two ports-of-call for cruise ships in 1993 were Miami and San Juan, Puerto Rico, accounting for 41 percent of all cruise ship port calls. (USDOT FHWA FTA MARAD 1995, 243) The increase in boat ownership shows the growth of recreational boating, which went from 8.6 million in 1980 to 11.4 million in 1994.

Nonmotorized Transportation

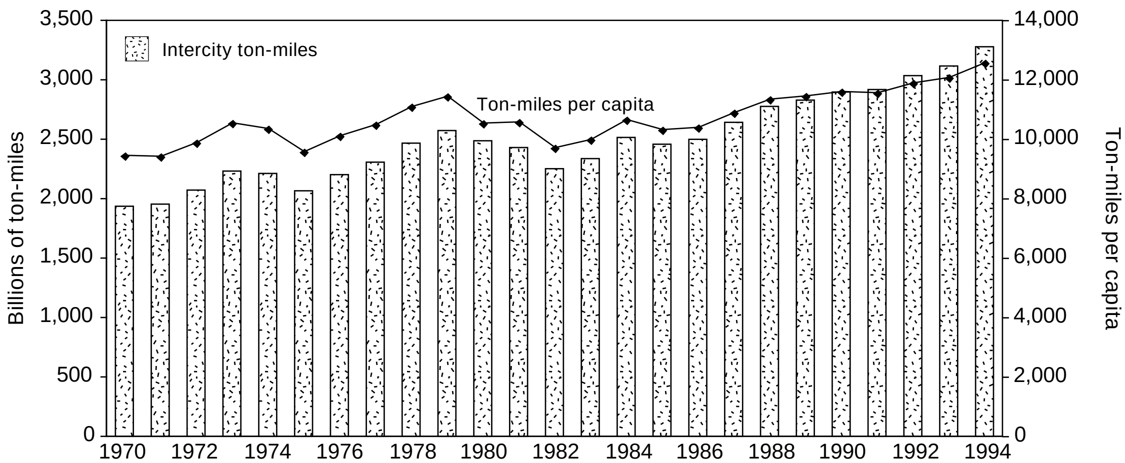
Nearly 8 percent of all personal trips in 1990 were by nonmotorized forms of transportation, 7.2 percent on foot and 0.7 percent by bicycle. (USDOT FHWA 1993a, 4-41) Because pedestrian and bicycle trips are short (averaging 0.6 miles and 2 miles, respectively), they accounted for only about 0.5 percent of all passenger-miles in 1990. In its study of commuting behavior, the Census Bureau found that 4.5 million people (4 percent of the employed civilian labor force) commuted to work by walking, a decline from 5.6 percent in 1980. In addition, 0.5 million people bicycled to work in 1990. (USDOT FHWA 1993b) Bicycle production and importation increased rapidly over the past two decades. Domestic shipments of bicycles increased from 5.6 million in 1975 to 8 million in 1993, and bicycle imports grew from 1.7 million in 1970 to 5 million in 1993. (USDOC Bureau of the Census 1995, 259; USDOT FHWA 1994)

Movement of Freight

Intercity (nonlocal) freight transportation increased substantially between 1970 and 1994 for all modes. The most rapid growth was in air cargo ton-miles, which increased by 434 percent. (USCAB 1973; USDOT BTS 1995) A direct estimate of the growth in ton-miles of freight carried by truck is not available, but the increase in vmt of combination trucks, assuming average load did not change, yields an estimate of 210 percent. (USDOT FHWA 1986 and 1995) The ton-miles carried by major railroads (Class I[5]) increased by 57 percent (AAR 1995a, 27), while ton-miles carried by oil pipelines rose 41 percent. (Eno Foundation for Transportation 1995, 44) Freight moved by water grew the slowest over this period, increasing by 37 percent. (U.S. Army Corps of Engineers 1994) As figure 1-7 shows, intercity ton-miles summed across all modes increased steadily since the early 1980s, the last time an economic recession caused a major reduction in freight transportation. (Eno Foundation for Transportation 1995)

[5]Defined as railroads with operating revenue above $255.8 million in 1994.

FIGURE 1-7: INTERCITY FREIGHT TRANSPORTATION, 1970–94



SOURCE: Eno Transportation Foundation, *Transportation in America* (Lansdowne, VA: 1995).

BTS is now able to report on how much freight was moved in a year by all modes in the United States, including trucking and intermodal combinations, and for intercity and local freight transportation. This information is provided for 1993 by the Commodity Flow Survey (CFS), conducted by BTS and the Bureau of the Census. The CFS differs from other published data in several ways. First, it provides survey data of freight movement. Second, it includes both intercity and local freight movement. Third, the CFS identifies parcel, post, and courier as a separate category, giving lower estimates of air freight cargo. Fourth, the CFS includes coastwise movement of goods often ignored elsewhere. Fifth, there are some definitional differences in the CFS, such as rail, which produce different estimates of modal share. Finally, the CFS estimates for the first time freight carried by intermodal combinations.

Preliminary results from the CFS show that the nation's freight transportation systems carried goods worth more than $6.3 trillion weighing 12.4 billion tons, yielding a total of 3.7 trillion ton-miles in 1993. As shown in figure 1-8, over half the weight of all freight was moved by truck, with rail, water, and pipeline transport accounting for most of the remaining tonnage. In terms of ton-miles, the split between truck, rail, water, and pipeline transportation is more even, given the greater distances moved by large shipments in the nonhighway modes. In terms of value, however, nearly three-quarters of all shipments moved by truck, followed by postal, parcel, and courier service, rail, water, and pipeline.

The CFS shows the importance of local transportation to the nation's commerce (see figure 1-9). Nearly 30 percent of the value and over 56 percent of the tons of all shipments measured by the CFS are shipped between places less than 50 miles apart. Of course, significant quantities of goods are also shipped long distances. For example, for shipments originating in California, the major destinations by value include Texas, Arizona, New York, Illinois, and Florida. California is among the major destinations of shipments from Maine.

► Domestic Freight Transportation

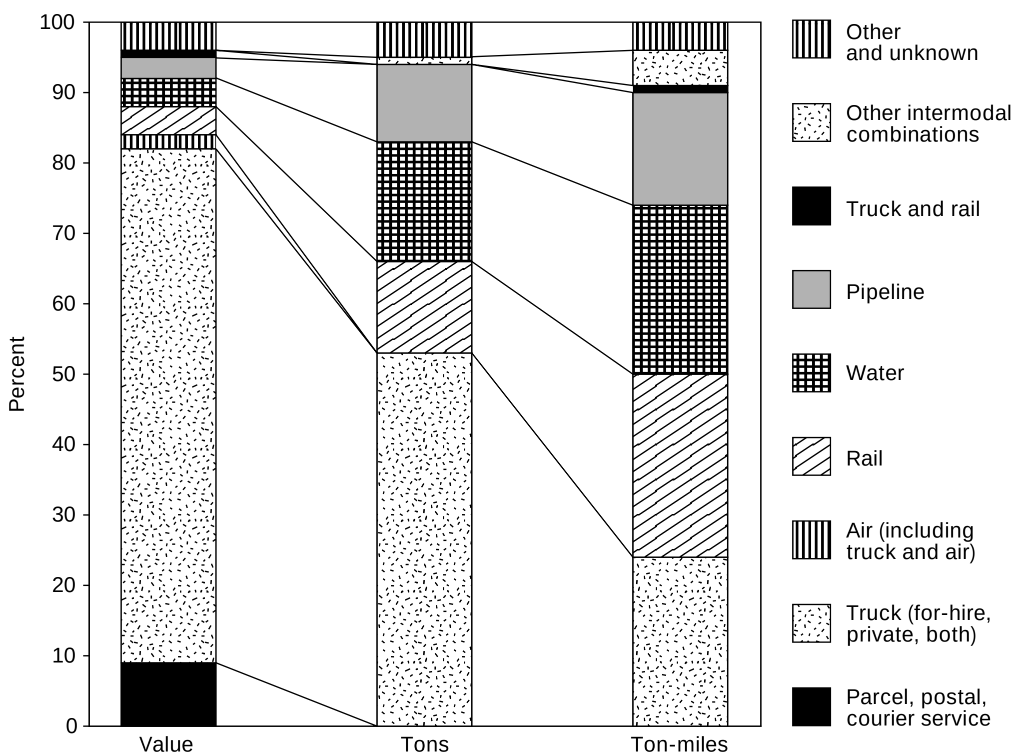
Trucks and Trains

The growth of trucking has been dramatic. According to the Census Bureau's Truck Inventory and Use Survey, the number of trucks increased 76 percent between 1982 and 1992, and the distance they traveled more than doubled (see table 1-3). While much of the growth was in personal use vehicles, trucks used in for-hire transportation increased by nearly 25 percent in number and over 50 percent in miles traveled during that period.

Two-axle trucks are the most common commercial trucks, but travel fewer miles per vehicle than the combination trucks with one or more trailers that are so visible on major highways (see table 1-4). Combination trucks with more than one trailer traveled the farthest per vehicle in 1992, but generated far less total travel than single combination trucks (most typically a three-axle tractor with a two-axle semi-trailer).

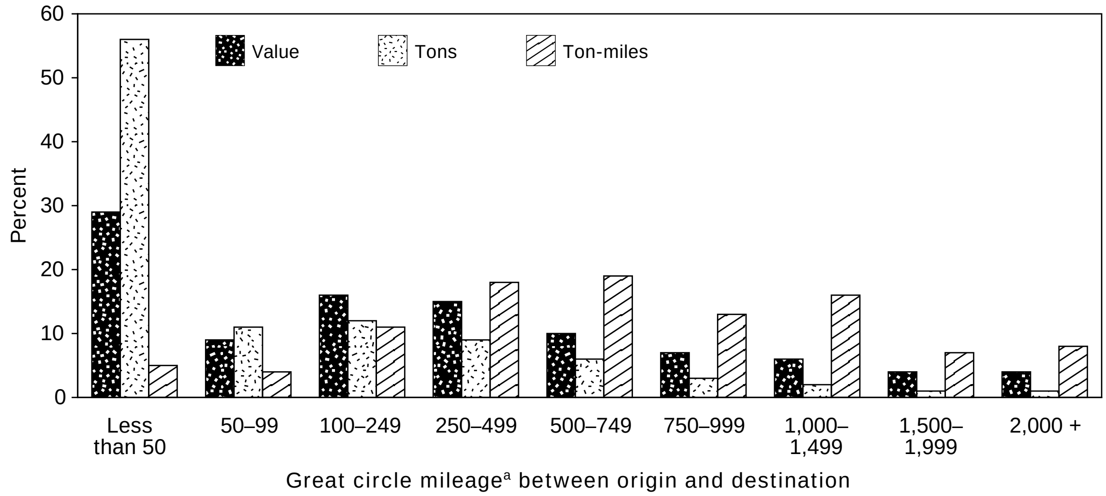
The truck fleet appears to be getting heavier as well as traveling farther (see table 1-5). Between 1982 and 1992, trucks with operating weights

FIGURE 1-8: VALUE, TONS, AND TON-MILES OF FREIGHT SHIPMENTS BY MODE, 1993



SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, "1993 Commodity Flow Survey: Preliminary Observations," August 1995.

FIGURE 1-9: VALUE, TONS, AND TON-MILES OF FREIGHT SHIPMENTS BY DISTANCE, 1993



[a]Great circle mileage is the shortest distance between two points on the surface of a sphere, lying in a plane that intersects the sphere's center.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, "1993 Commodity Flow Survey: Preliminary Observations," August 1995.

above 80,000 lbs. increased in number by 181 percent and in miles traveled by 193 percent. Trucks below 33,000 lbs. increased 78 percent in number and 120 percent in miles traveled. Trucks of intermediate weight increased substantially less in numbers and miles traveled.

In 1994, railroads carried the most originating tons in a decade. (AAR 1995b, 28) Of the 1.5 billion tons of freight originating on Class I carriers, coal accounted for 39 percent, chemicals and allied products for 10 percent, and farm products for 9 percent. (AAR 1995b, 29) Moreover, the average length of haul increased from 224 miles in 1944 to 817 miles in 1994. (AAR 1995b, 36)

Rail freight flows are shown in figure 1-10. Particularly prominent are traditional east-west oriented routes, especially in the West. Coal shipments explain the large east-west volumes through Wyoming and Nebraska and through Virginia and West Virginia. The map also shows the prominence of North American Free Trade Agreement (NAFTA)-supporting routes such as the routes between the Midwest and Texas.

Water and Pipelines

Domestic waterborne freight transportation includes coastwise, internal, and lakewise movements. Coastwise movement is defined as domestic traffic with carriage over the ocean or the Gulf of Mexico. In 1994, 56 percent of ton-miles of domestic waterborne freight moved coastwise. Internal freight transportation is defined as traffic taking place solely on inland waterways, and accounted for 37 percent of ton-miles. Lakewise movement, 7 percent of freight-miles, is defined as domestic traffic between ports on the Great Lakes. Between 1970 and 1994, internal transport nearly doubled, while coastwise movement increased by 27 percent. Lakewise freight transport decreased 27 percent over this period. (US Army Corps of Engineers various years)

The principal commodities moved by pipeline are oil and gas. Intercity ton-miles of oil moved

Intermodal

The CFS provides the first comprehensive picture of intermodal transportation (see box 1-1). About 38 million tons, worth $83 billion, moved by the classic intermodal combination of truck and rail. Assuming 50,000 pounds of payload per truck, this intermodal combination means that 1.5 million large trucks were diverted from the highways for a major part of their trips. Fast, flexible forms of intermodal transportation have emerged in recent years. For example, parcel, postal, and courier services now account for about 9 percent of the value of

Table 1-3: Number of Trucks, Miles Traveled, and Miles Per Truck by Truck Use, 1982 and 1992

Use	1982	1992	Change (percent)[a]
Number of trucks (thousands)			
For-hire transportation	718	888	24
Other business use	13,611	15,704	15
Mixed and daily rental	168	1,524	807
Personal Use	19,214	41,076	114
Total (including unknown)	33,722	59,191	76
Vehicle-miles traveled (billions)			
For-hire transportation	33.1	51.8	57
Other business use	173.4	244.5	41
Mixed and daily rental	3.4	25.6	661
Personal Use	166.4	464.2	179
Total (including unknown)	376.2	786.1	109
Miles per truck (thousands)			
For-hire transportation	46.1	58.3	27
Other business use	12.7	15.6	22
Mixed and daily rental	20.0	16.8	–16
Personal Use	8.7	11.3	31
Total (including unknown)	11.2	13.3	19

[a]Percentages may not add due to rounding.

NOTES: For-hire transportation = motor carrier + owner/operator + mixed private common.
Other business use = business use.
Mixed and daily rental = mixed + daily rental.
Personal use = personal.
Total (including unknown) = all.

SOURCE: Oak Ridge National Laboratory tabulations from the Truck Inventory and Use Survey public use microdata files.

Table 1-4: Number of Trucks, Miles Traveled, and Miles Per Truck by Truck Type, 1982 and 1992

Type	1982	1992	Change (percent)[a]
Number of trucks (thousands)			
Multiple combination	30	59	98
Single combination	1,303	1,670	28
2 axles, 6 tires	6,956	3,363	–52
2 axles, 4 tires	25,433	54,099	113
Total	33,722	59,191	76
Vehicle-miles traveled (billions)			
Multiple combination	1.9	4.7	152
Single combination	53.1	74.7	41
2 axles, 6 tires	74.9	37.8	–50
2 axles, 4 tires	246.4	668.8	171
Total	376.2	786.1	109
Miles per truck (thousands)			
Multiple combination	62.2	79.2	27
Single combination	40.8	44.7	10
2 axles, 6 tires	10.8	11.3	5
2 axles, 4 tires	9.7	12.4	29
Total	11.2	13.3	19

[a]Percentages may not add due to rounding.

SOURCE: Oak Ridge National Laboratory tabulations from the Truck Inventory and Use Survey public use microdata files.

by pipeline increased from 431 billion in 1970 to 608 billion in 1994. (Eno Foundation 1995) Gas moved by pipeline, measured in cubic feet, has remained almost unchanged from 1970 to 1994 at about 20 trillion cubic feet. (USDOE 1995)

TABLE 1-5: NUMBER OF TRUCKS, MILES TRAVELED, AND MILES PER TRUCK BY TRUCK WEIGHT, 1982 AND 1992

Weight (thousand lbs[a])	1982	1992	Change (percent)[b]
Number of trucks (thousands)			
<33	32,436	57,562	78
33-60	674	798	18
60-80	594	781	32
>80	18	50	181
Total	33,722	59,191	76
Vehicle-miles traveled (billions)			
<33	322	709	120
33-60	18	24	29
60-80	35	51	46
>80	0.9	2.5	193
Total	376	786	109
Miles per truck (thousands)			
<33	9.9	12.3	24
33-60	27.2	29.6	9
60-80	59.1	65.3	11
>80	47.4	49.5	4.4
Total	11.2	13.3	19

[a]Thousands of pounds of typical operating weight.
[b]Percentages may not add due to rounding.

SOURCE: Oak Ridge National Laboratory tabulations from the Truck Inventory and Use Survey public use microdata files.

all shipments. When shipments reported as being sent by more than one mode are added to those sent by parcel and courier services, intermodal transportation exceeds 200 million tons valued at $660 billion.

Intermodal shipments tend to be high in value. Shipments by parcel, postal, and courier services average $15.08 per pound; truck-rail intermodal shipments are worth $1.09 per pound. Although short of the $26.77 value per pound of air and air-truck shipments, these intermodal shipments are higher in value than the 35 cents per pound for truck-only shipments and the less than 10 cents per pound for railroads, water transport, and pipeline shipments.

International Freight Transportation

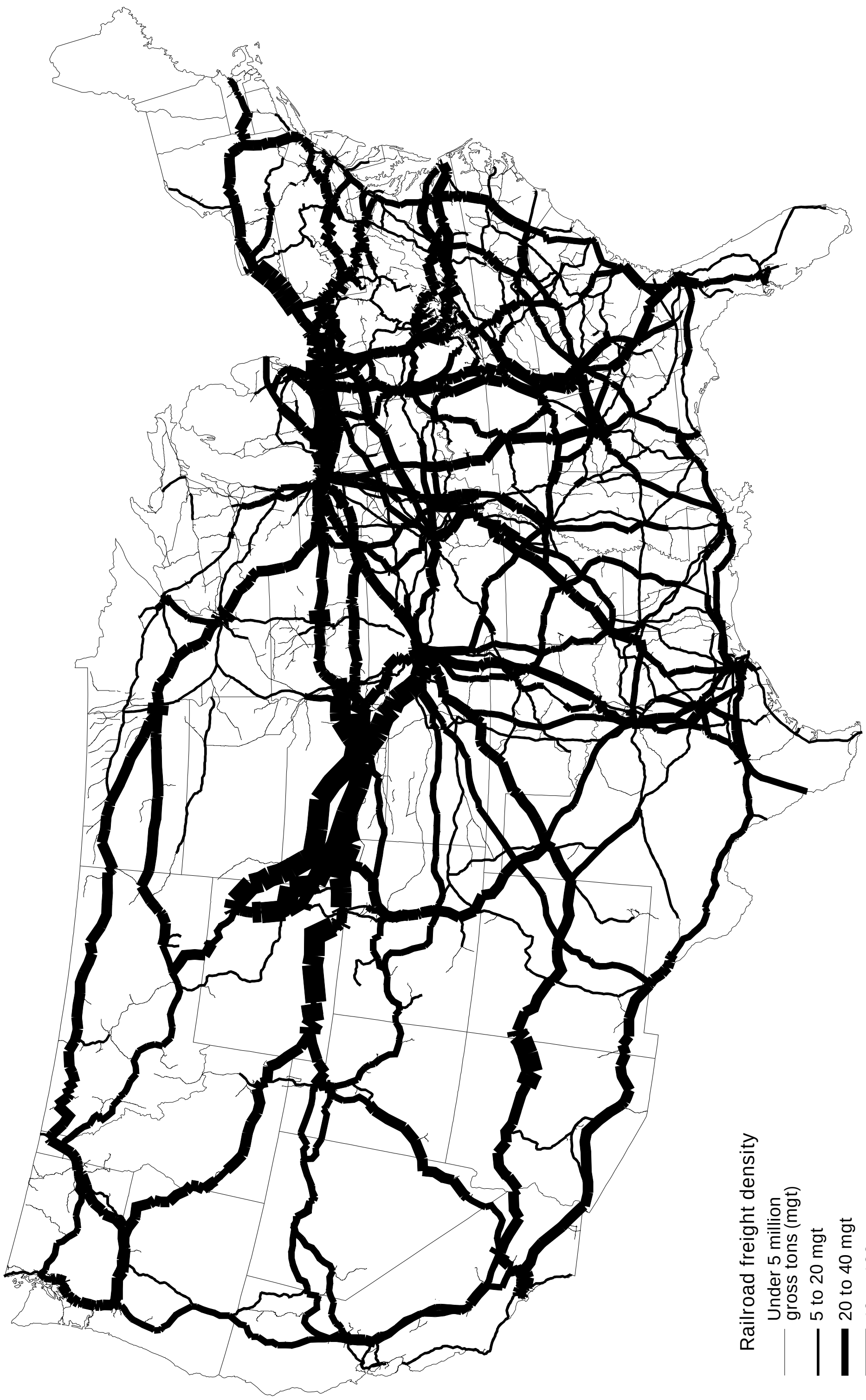
International trade is a source of growth in transportation, placing demands on the domestic transportation system for access between ports of entry or exit and the interior. The value of commodities exported and imported in 1993 was about one-sixth the value of commodities counted in the CFS. (USDOC Bureau of the Census 1995, table 1081; USDOT BTS 1995, table 131) NAFTA increased the importance of north-south movements relative to the traditional east-west movement of goods in international trade. Based on information collected for BTS by the Census Bureau:

- $259.3 billion in goods moved by land between Canada and the United States between April 1994 and March 1995, an increase of more than 15 percent over the preceding 12 months. In terms of value, 76 percent moved by truck, 20 percent by rail, and 4 percent by pipeline.
- More than $90 billion in goods moved by land between Mexico and the United States between April 1994 and March 1995, an increase of over 15 percent over the preceding 12 months. In terms of value, 87 percent moved by truck and 14 percent by rail.

During the 12 months ending in March 1995:

- The top three border crossings in value of shipments for surface freight to and from Canada were Detroit (32 percent of northbound traffic and 29 percent of southbound), Buffalo (18 percent of northbound traffic and 20 percent of southbound), and Port Huron, Michigan (9 percent of northbound traffic and 10 percent of southbound).
- The top three border crossings in value of shipments for southbound surface freight to Mexico were in Texas: Laredo (40 percent), El Paso (16 percent), and Brownsville (8 percent).
- The top three border crossings in value of shipments for northbound surface freight from Mexico were El Paso (24 percent),

FIGURE 1-10: RAILROAD NETWORK SHOWING VOLUME OF FREIGHT, 1994



SOURCE: U.S. Department of Transportation, Federal Railroad Administration, *Carload Waybill Statistics: Territorial Distribution, Traffic and Revenue by Commodity Class* (Springfield, VA: National Technical Information Service, 1995).

Box 1-1: Intermodalism

In a departure from the transportation community's historic focus on individual modes, the Intermodal Surface Transportation Efficiency Act recognized the growing importance of intermodalism. The term intermodalism is used in three ways.

Most narrowly, it refers to containerization, piggyback service, and other technologies that provide the seamless movement of goods and people by more than one mode of transport.

More broadly, intermodalism refers to providing connections among different modes, such as adequate highways to ports or bus feeder services to rail transit. In its broadest interpretation, intermodalism refers to a view of transportation in which individual modes work together or within their own niches to provide the user with the best choices of service, and in which the consequences on all modes of policies for a single mode are considered. In the past, this view was called balanced, integrated, or comprehensive transportation.

Finally, Congress and others frequently use the term intermodalism as a synonym for multimodal transportation, without necessarily requiring an integrated approach.

The Bureau of Transportation Statistics (BTS) accepts the broadest interpretation of intermodalism in its philosophy, but prefers the middle ground in its use of the term. BTS collects and reports information on multimodal transportation systems, including both individual modes and intermodal combinations.

Laredo (24 percent), and San Ysidro, California (11 percent).

These patterns may change if the areas in which motor carriers can operate across the border are expanded (see figure 1-11). Until NAFTA, foreign trucks on both sides of the Mexico-U.S. border could operate only in a narrow commercial zone. A provision of NAFTA allows foreign trucks to operate in border states, although the implementation of this policy has been delayed.

While transborder land crossings are important, most international trade moves in and out of the United States through ports. Seaports handled international cargo valued at $517 billion in 1994, an increase of 81 percent from 1980.

Figure 1-12 illustrates the geographic pattern of port activity. The concentrations of tonnage in Texas, Louisiana, Alaska, and the Delaware River arise in large part from petroleum products. Louisiana also handles a significant amount of grain. The large ports with the most general cargo are in the New York metropolitan area and California.

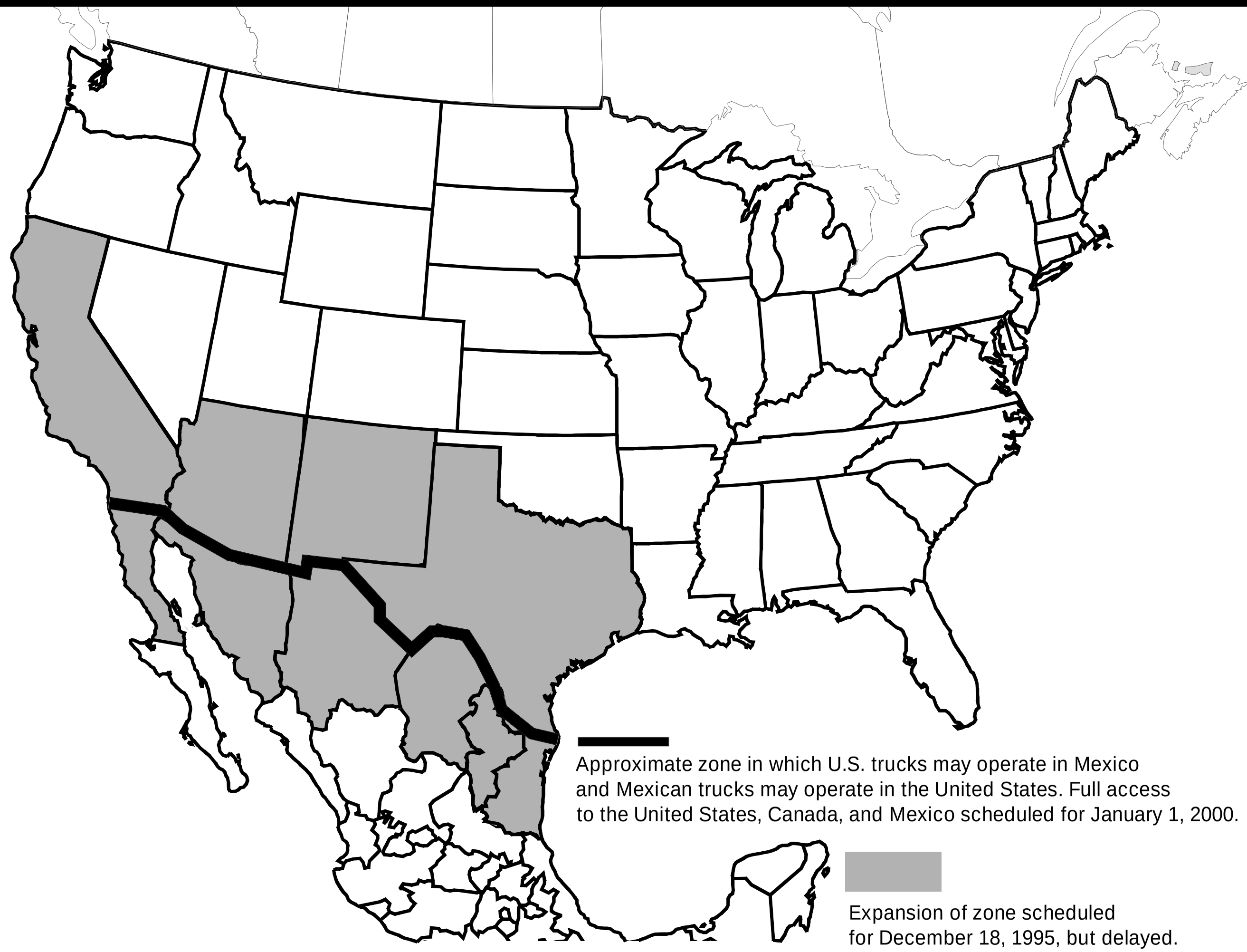
The pattern of demand is shifting significantly among regions, as illustrated by the growth of intermodal container traffic through east coast and west coast ports. Since 1980, growing Pacific Rim trade has benefited west coast ports (see figure 1-13). In 1980, west coast ports accounted for about 24 percent of the value of U.S. oceanborne foreign trade, and east coast ports 41 percent. By 1993, west coast ports almost doubled their share to 45 percent, while the share handled by east coast ports declined to 38 percent.

Where Passengers and Freight Meet

Most highways, railways, airports, and seaports carry both passengers and freight, a source of efficiency and inefficiency. Joint use of the system allows for fuller utilization of the infrastructure. The overlap between passengers and freight on the transportation network, however, means competition for network space, scheduling conflicts, and possible safety, noise, congestion, and environmental problems.

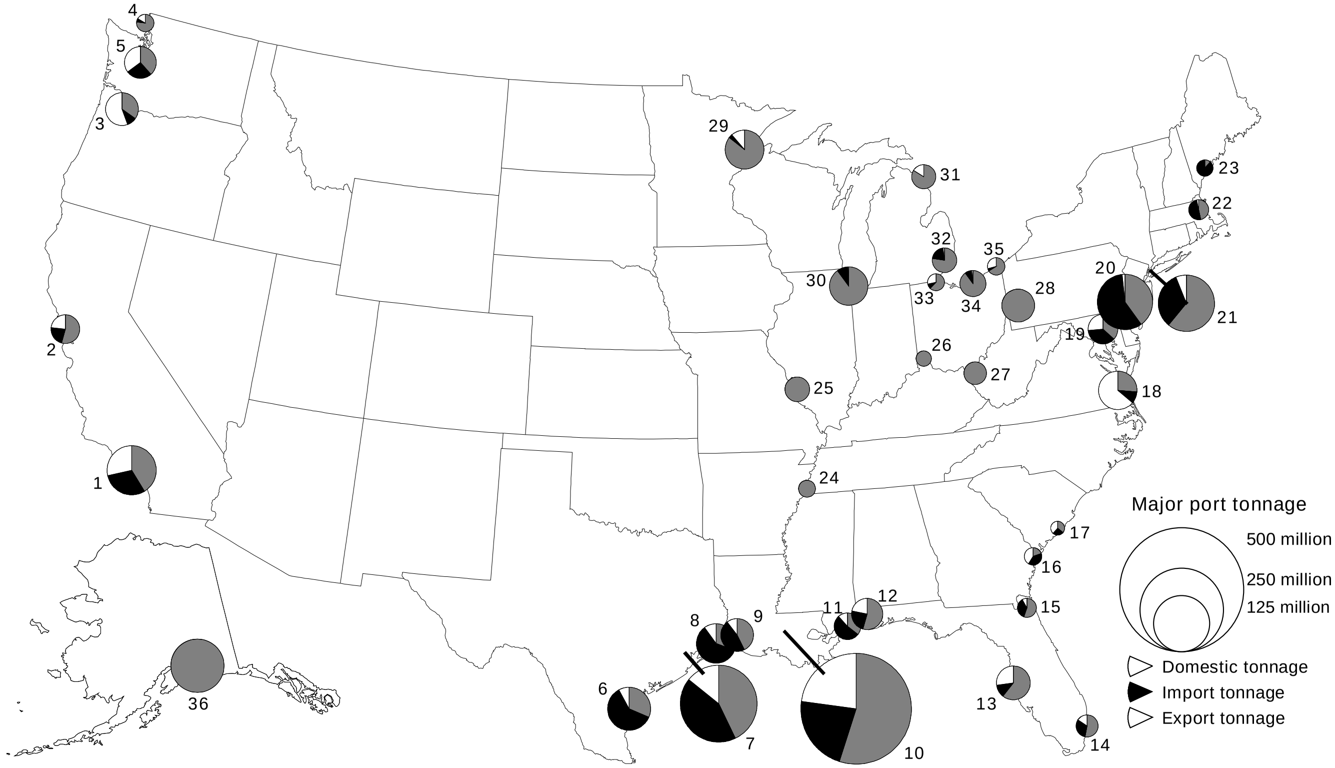
Trucks and cars share virtually all major roads. The exceptions, roads limited to passenger vehicles, include parkways, bus and high-occupancy-vehicle lanes, and some major

FIGURE 1-11: TRANSBORDER TRUCK ACCESS



SOURCE: U.S. General Accounting Office, *Commercial Trucking Safety and Infrastructure Issues Under the North American Free Trade Agreement,* GAO/RCEO-96-61 (Washington, DC: U.S. Government Printing Office, February 1996).

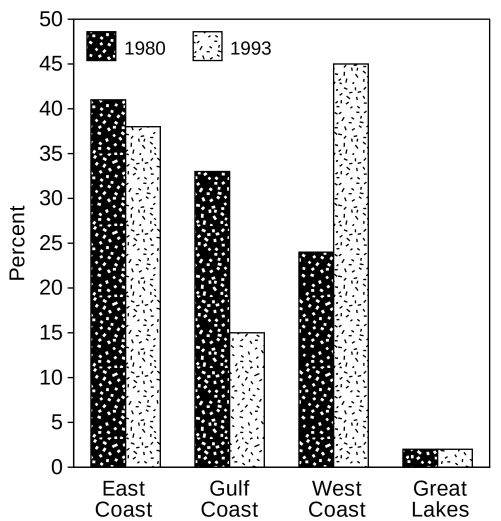
FIGURE 1-12: TONNAGE HANDLED BY MAJOR U.S. PORTS, 1994



1. Los Angeles-Long Beach
   Los Angeles, CA
   Long Beach, CA
2. San Francisco Bay
   San Francisco, CA
   Oakland, CA
   Richmond, CA
3. Columbia River
   Portland, OR
   Vancouver, WA
   Longview, WA
   Kalama, WA
4. Northern Puget Sound
   Port Angeles, WA
   Port Townsend, WA
   Anacortes, WA
   Bellingham, WA
5. Southern Puget Sound
   Seattle, WA
   Tacoma, WA
   Everett, WA
   Olympia, WA
6. Corpus Christi
   Corpus Christi, TX
7. Houston-Galveston
   Houston, TX
   Galveston, TX
   Freeport, TX
   Texas City, TX
8. Beaumont-Port Arthur
   Beaumont, TX
   Port Arthur, TX
   Orange, TX
9. Lake Charles
   Lake Charles, LA
10. South Louisiana
    Port of South Louisiana
    New Orleans
    Baton Rouge
    Port of Plaquemine
11. Biloxi - Gulfport
    Biloxi, MS
    Gulfport, MS
    Pascagoula, MS
12. Mobile
    Mobile, AL
13. Tampa
    Tampa Bay, FL
14. Miami
    Port Everglades, FL
    Miami, FL
15. Jacksonville
    Jacksonville, FL
16. Savannah
    Savannah, GA
17. Charleston
    Charleston, SC
18. Norfolk-Newport News
    Norfolk Harbor, VA
    Newport News, VA
    Richmond, VA
    Hopewell, VA
    Cape Charles, VA
19. Baltimore
    Baltimore, MD
20. Delaware River
    New Castle, DE
    Wilmington, DE
    Marcus Hook, DE
    Paulsboro, PA
    Chester, PA
    Philadelphia, PA
    Camden-Gloucester, NJ
21. New York
    New York, NY
22. Boston
    Boston, MA
    Salem, MA
23. Portland
    Portland, ME
24. Memphis
    Memphis, TN
25. St. Louis
    St. Louis, MO
26. Cincinnati
    Cincinnati, OH
27. Huntington
    Huntington, WV
28. Pittsburgh
    Pittsburgh, PA
29. Duluth-Superior
    Duluth-Superior, MN
    Two Harbors, MN
    Silver Bay, MN
    Ashland, WI
    Taconite, MN
30. Chicago-Gary
    Chicago, IL
    Indiana Harbor, IN
    Gary, IN
    Buffington, IL
    Burns Waterway Harbor, IN
31. Alpena
    Alpena, MI
    Calcite, MI
    Stoneport, MI
    Presque Isle, MI
32. Detroit
    Detroit, MI
    Marine City, MI
    St. Clair, MI
    Port Huron, MI
33. Toledo
    Toledo, OH
    Monroe, MI
34. Cleveland-Lorain
    Cleveland, OH
    Lorain, OH
    Fairport Harbor, OH
35. Ashtabula
    Ashtabula, OH
    Conneaut, OH
36. Valdez
    Valdez, AK

SOURCE: U.S. Army Corps of Engineers, *Waterborne Commerce of the United States: Calendar Year 1994* (New Orleans, LA: 1995).

FIGURE 1-13: REGIONAL SHARE OF TOTAL ANNUAL VALUE OF OCEANBORNE FOREIGN TRADE, 1980 AND 1993



SOURCE: U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States, 1995* (Washington, DC: U.S. Government Printing Office, 1995), p. 664.

highways like the automobile lanes of the New Jersey Turnpike. Local roads may restrict the largest trucks, but allow smaller trucks in addition to automobiles.

In the case of railroads, passenger service usually occurs over rail lines that primarily carry freight. For example, freight companies and other entities own most of the more than 25,000 miles of railroad track used by Amtrak. (The notable exception is the Northeast Corridor, which is largely owned by Amtrak). The overlap of passenger and freight has raised capacity and safety issues.

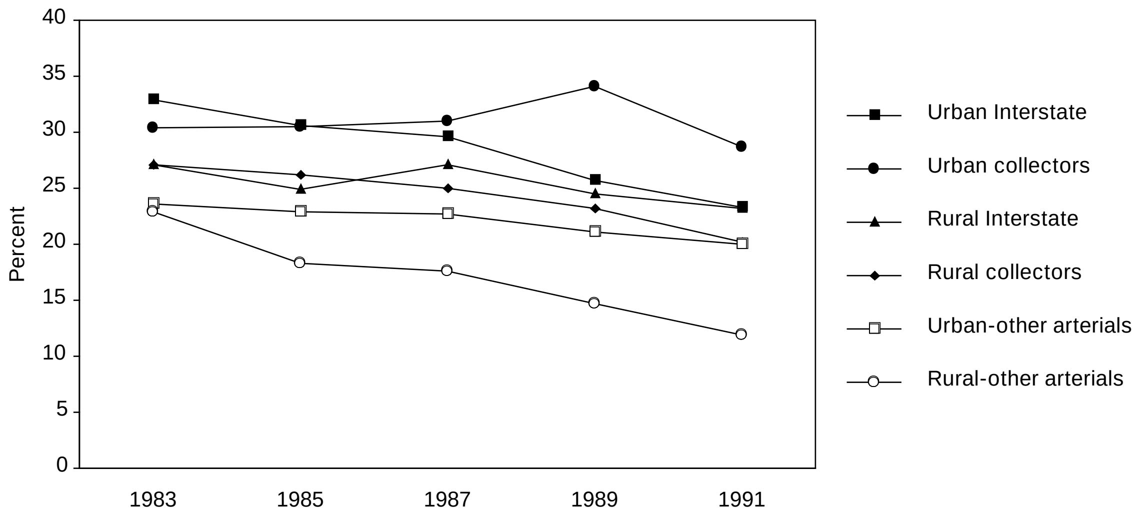
In water transportation, the growth in popularity of recreational boating means more conflicts with waterborne freight movement are possible, particularly in redeveloped older harbor areas. Moreover, landside access to U.S. ports can create conflicts between passenger and freight transportation. A recent report by DOT's Maritime Administration found that the efficiency of more than half of U.S. ports is threatened by increasing passenger car congestion on truck routes. Congestion is made worse at many ports by rail lines that intersect local streets. (USDOT MARAD 1993) Also, some container ports are not served by tunnels or bridges able to carry double-stack trains. Moreover, ports in many metropolitan areas cannot expand or be reconfigured because of competition with other land uses.

In the aviation industry, the overlap between passengers and air cargo (freight, mail, and air express) has increased efficiency. Wide-body aircraft, in use since the late 1960s, allow almost all passenger carriers to carry both cargo and passengers. Much of the all-freight business occurs in overnight parcel delivery, allowing passenger services to operate unimpeded during the day. Some conflict arises at airports, where most air cargo arrives and leaves on trucks traveling over highways through metropolitan areas.

Physical Condition and Performance

The U.S. Department of Transportation monitors the condition and performance of the transportation system. This section discusses indicators to assess the condition of the system and examines performance measures from the perspective of the user. Ideally, performance would be judged on a systemwide basis regardless of how many modes it involved. The current data, however, only allow performance evaluations of each mode separately. Other measures of system condition and performance, such as economic condition, safety, and environmental performance, are discussed elsewhere in this report.

FIGURE 1-14: HIGHWAY MILEAGE IN POOR AND MEDIOCRE CONDITION BY FUNCTIONAL SYSTEM, 1983–91



SOURCE: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* (Washington, DC: various years).

▶ Highways

According to the *1995 Status of the Nation's Surface Transportation System: Condition and Performance*:

- Between 1983 and 1991, highway pavement conditions improved as measured by the Present Serviceability Rating (see figure 1-14). For example, the percentage of urban Interstates in poor or mediocre condition dropped from 32.9 percent in 1983 to 23.2 percent in 1991. The corresponding drop for rural Interstates is 27.1 to 23.2 percent. Because of a change to a new measure, the International Roughness Index (IRI), it is difficult to say anything about more recent trends in pavement condition. (USDOT FHWA FTA MARAD 1995, 121–131) Table 1-6 shows the condition of roads in 1994.
- Bridge conditions have improved over the past few years (see table 1-7). The number of deficient bridges on Interstates, arterials, and collectors have all decreased between 1990 and 1994. Approximately one-quarter of these bridges are still deficient. (USDOT FHWA FTA MARAD 1995, 132–135)

Congestion, one measure of performance, can be expressed in total vehicle-hours of delay. One estimate of urban roadway congestion suggests that vehicle-hours of delay in 50 cities increased from 8.7 million per day in 1986 to 11 million per day in 1992. (Texas Transportation Institute 1995) Congestion estimates are supported by calculating highway vmt per lane-mile. In every category, vmt per lane-mile increased between 1985 and 1994; the greatest increase was on urban arterials (see table 1-8).

▶ Transit

The condition of urban transit equipment has not changed greatly from 1985 to 1993 (see table 1-9). Although the fleet of large and mid-size buses has become older, many smaller

Table 1-6: Pavement Condition, 1994

	Poor	Mediocre	Fair	Good	Very good	Unpaved	Total
Interstate (miles)[a]	3,607	11, 954	10,561	13,742	4,682	0	44,546
Percent of system	8	27	24	31	11	0	100
Other arterials (miles)	43,788	95,226	99,016	87,274	46,025	306	371,635
Percent of system	12	26	27	23	12	0	100
Collectors (miles)	36,304	62,750	178,786	84,200	108,331	46,838	517,209
Percent of system	7	12	35	16	21	9	100
Total (miles)	83,699	169,930	288,363	185,216	159,038	47,144	933,390
Percent of system	9	18	31	20	17	5	100

[a]Interstates are held to a higher standard than other roads because of higher volumes and higher speed.

KEY: Poor = needs immediate improvement.
Mediocre = needs improvement in the near future to preserve usability.
Fair = will likely need improvement in the near future, but depends on traffic use.
Good = in decent condition; will not require improvement in near future.
Very good = new or almost new pavement, will not require improvement for some time.

NOTE: Because of the switch to the International Roughness Index (IRI) from the Present Serviceability Rating (PSR) some states are reporting the PSR for some facilities and the IRI for others. As a result, this table portrays a mixture of the two rating schemes. Several years of measurement using the IRI procedures are needed to define an accurate trend in pavement condition.

SOURCE: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1994* (Washington, DC: 1995).

Table 1-7: Bridge Conditions, 1990 and 1994

	1990	1994
Interstate bridges	53,183	54,726
Number deficient	15,208 (28.6%)	13,262 (24.2%)
Other arterial bridges	124,615	129,465
Number deficient	39,492 (31.7%)	36,199 (28%)
Collector bridges	164,300	162,314
Number deficient	56,622 (34.5%)	45,330 (27.9%)

NOTE: Deficient bridges include a) structurally deficient bridges—those that need significant maintenance, attention, rehabilitation, and sometimes replacement; and b) functionally deficient bridges—those that do not have the lane widths, shoulder widths, or vertical clearances to serve traffic demand.

SOURCE: U.S. Department of Transportation, Federal Highway Administration, Federal Transit Administration, and Maritime Administration, *1995 Status of the Nation's Surface Transportation System: Condition and Performance* (Washington, DC: Oct. 27, 1995), pp. 132–134.

buses and vans were added for paratransit services over the past few years. These new vehicles have resulted in no change in the average age of all urban transit buses nor has the per-

Table 1-8: Annual Highway Vehicle-Miles Traveled per Lane-Mile by Functional Class, 1985 and 1994

	1985 vmt/lm	1994 vmt/lm	Change (percent)
Rural Interstate	1,170,452	1,644,613	41
Rural arterial	554,290	674,765	22
Rural collector	140,943	161,204	14
Urban Interstate	3,770,649	4,674,863	24
Urban arterial	1,082,705	1,804,094	67
Urban collector	552,098	654,972	19

KEY: vmt = vehicle-miles traveled; lm = lane-miles.

SOURCE: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1994* (Washington, DC: 1995).

centage of overage full-size buses changed significantly over this period. For rail transit, significant improvement occurred in the condition of power systems, stations, structures (e.g., bridges and tunnels), and maintenance between 1984 and 1992. (USDOT FHWA FTA MARAD

Table 1-9: Urban Transit Bus Condition, 1985 and 1993

	1985	1993
Articulated buses		
Total fleet	1,423	1,807
Number of overage vehicles	0	295
Average age (years)	3.4	9.5
Full-size buses		
Total fleet	46,138	46,824
Number of overage vehicles	9,277	9,362
Average age (years)	8.1	8.5
Mid-size buses		
Total fleet	2,569	3,598
Number of overage vehicles	237	865
Average age (years)	5.6	6.4
Small buses		
Total fleet	1,685	4,064
Number of overage vehicles	280	513
Average age (years)	4.8	4.0
Vans		
Total fleet	1,733	8,353
Number of overage vehicles	790	1,804
Average age (years)	3.8	3.1
Total		
Total fleet	51,863	60,582
Number of overage vehicles	10,584	12,839
Average age (years)	7.9	7.9

SOURCE: U.S. Department of Transportation, Federal Highway Administration, Federal Transit Administration, and Maritime Administration, *1995 Status of the Nation's Surface Transportation System: Condition and Performance* (Washington, DC: Oct. 27, 1995), p. 137.

1995, 143) The average age of rail transit vehicles, however, has not changed between 1985 and 1993. But the condition of powered commuter-railcars worsened significantly because of age: these cars averaged 12.3 years in age in 1985 and 18.2 years in age in 1993. (USDOT FHWA FTA MARAD 1995, 144)

One performance measure for transit is speed of service. No data are available on the average speed of passenger trips, but there is information on the average speed of transit service. Weighting this information by passenger-miles produces a useful indicator. Rail speed increased from 24.8 to 26.3 miles per hour from 1984 to 1993 and bus speed increased from 12.9 to 13.7 miles per hour. (USDOT FHWA FTA MARAD 1995, 116)

► Air Transportation

Data for a complete condition and performance measurement system in air transportation do not exist. The Federal Aviation Administration (FAA), however, does compile data on the condition of airports and aircraft. For the air traveler, an important element of the performance of commercial air service is delays and on-time performance. FAA, therefore, also compiles performance data on airport and air traffic delay. The Office of Airline Information, part of BTS, collects data on air carrier on-time performance.

Runway Condition

In 1993, 79 percent of commercial service airports had runways with pavement condition rated good, 18 percent fair, and 3 percent poor. This is an improvement over 1986 when 78 percent were rated good, 15 percent fair, and 7 percent poor. (USDOT FAA 1995, 19)

Aircraft Condition

While the age of aircraft (one measure of condition) appears to have a strong relationship to the financial condition of air carriers, regulations being considered by FAA would require special maintenance and the retirement of older planes. The average age of aircraft owned by major U.S. companies was 11.4 years in 1992; in 1983 the average age was 10.5. The average age of aircraft in the U.S. airline industry as a whole increased from 10 years in 1983 to 11.5 in 1992. (USDOT Office of Airline Information)

On-Time Performance

A flight is considered on-time if it arrives at the gate less than 15 minutes after the scheduled arrival time. Canceled and diverted flights are considered late. In 1994, the proportion of on-time flights for major air carriers was 81.5 percent. Overall on-time performance improved from 1989 when the percent on time was 76.3. (USDOT BTS 1995, 75) Another measure is the number of passengers with confirmed seats that are either denied boarding or asked to let others occupy their seats. With a total of 841,000 denied boarding, 1994 was the worst year since 1987 when the number was 874,000; this is, however, a very small fraction of enplanements. (USDOT BTS 1995, 84)

Airport and Aircraft Delay

Most U.S. airports are uncongested, but seven airports had average airliner delays exceeding nine minutes in 1992 (the last year for which data were available), and are termed severely congested. Those were Boston Logan, Dallas-Fort Worth, Denver Stapleton, Newark, John F. Kennedy, La Guardia, and Chicago O'Hare. (USDOT FAA 1995, 10-11) Another indicator of congestion is the number of airports where delays to aircraft exceed 20,000 hours per year. There were 23 airports with such delay in 1992. One other indicator of congestion is average delay per aircraft operation (delay per departure and arrival over 15 minutes). Average delay per operation, 7.1 minutes in 1992, down from 7.4 minutes in 1990, is projected to increase to 7.7 minutes in 2002 if all the runways proposed in the National Plan of Integrated Airport Systems are built. (USDOT FAA 1995) Improvements in air traffic control, however, could prevent increased airspace delay. (USDOT FAA 1995, 12) FAA finds that the number of long delays (of 15 minutes or more) has been falling the past several years from 298,000 in 1991 to 237,000 in 1994. (USDOT FAA 1996)

► Rail

The condition of track, rolling stock (locomotives and cars), stations, and maintenance facilities is one aspect to consider in appraising rail transportation. In some situations these can be reported separately for passenger and freight service. Performance can also be measured by speed for both passenger and freight, and on-time performance for passenger services.

The condition of rail transportation systems is a tale of two industries. On the whole, the condition of the freight side is improving while passenger service (Amtrak) is deteriorating. On the freight side, 1.2 million railcars operated in 1994—virtually the same number as in the previous half-dozen years. In 1994, however, 51,000 new and rebuilt railcars were brought into the fleet—the greatest number in at least a decade—and these cars embody improved technology. (Welty 1995) Additionally, 1,216 new and rebuilt locomotives were added to the rail fleet in 1994, again the most in over a decade. (AAR 1995b, 54) Capital expenditures for equipment in 1994 were $1.7 billion, compared with $1.4 billion in 1993 and $874 million in 1992. Total capital expenditures, including roadway and structures, were $4.9 billion, a figure—although not corrected for inflation—never before attained by the rail industry. (AAR 1995b, 43)

By contrast Amtrak's equipment is old: the average age of its passenger cars was about 22 years and locomotives averaged over 13 years old in 1994. Despite some new equipment, the trend of the past decade has been for the average age of equipment to become even older. Amtrak's active locomotive fleet in 1994 was 338, but locomotive availability, which improved slightly the past two years, averages only about 85 percent during a typical day. (Amtrak 1995, 11) Some 66 percent of the locomotive fleet is at or beyond the locomotive's typical useful life; most passenger cars are half-way or more through their life-cycles. (Amtrak 1995, 13) Amtrak's contractors, the freight railroads, had only 77 serviceable passenger locomotives on January 1, 1995, having retired 21 locomotives during 1994. They replaced none in 1994 and had no new units on order. (AAR 1995a, 5)

On-time performance for Amtrak's trains was virtually the same in 1994 as in 1993, about 79 percent for short-distance trains, 50 percent for long-distance ones and about 72 percent overall.[6] On-time performance in 1994, however, was much worse than in 1984 when about 80 percent of all trains were on-time. Freight railroads over whose tracks Amtrak operates were responsible for 41.2 percent of delays in 1994 versus 38.8 percent in 1993. Amtrak-caused delays were 24.6 percent in 1994 and 25.7 percent in 1993. (Amtrak 1995, 10)

► Water Transportation

The report *1995 Status of the Nation's Surface Transportation System: Condition and Performance* provides some information on the waterborne transportation system, mostly on vessels. Of the 25,000 oceangoing vessels over 1,000 gross tons in 1995, approximately 543 sail under the U.S. flag. The U.S. fleet ranks 10th by deadweight capacity. The largest number of those, 187, are tankers. The U.S. fleet also contains 88 containerships, 50 roll-on/roll-off ships, 18 dry bulk carriers, and 8 cruise and passenger ships. The remaining 192 include breakbulk ships, partial containerships, refrigerated cargo ships, barge carriers, and specialized cargo ships. The U.S. domestic fleet, including those sailing on the Great Lakes, inland waterways, and along the coasts, consists of nearly 40,000 vessels. Approximately three-quarters of these are dry cargo barges and most of the rest are tankbarges and tug/towboats. The U.S. domestic fleet also includes 150 ferries. (USDOT FHWA FTA MARAD 1995, 202–203, 213)

Ports in the United States include deep-draft seaports, Great Lakes port facilities, and inland waterway ports. In 1993, there were 1,917 major U.S. seaport and Great Lakes terminals with 3,173 berths. Of these, 507 berths were in the Great Lakes system. In the same year, there were 1,789 river terminals, with nearly 97 percent in the Mississippi River System and the rest in the Columbia-Snake River System. Data on the condition of ports is limited to investment data on public shoreside port facilities. The data show that investment remained fairly constant from 1990 to 1993 at around $650 million per year. (USDOT FHWA FTA MARAD 1995, 218–222)

► Pipelines

With little new construction, pipeline throughput has remained relatively constant. The pipeline system is aging, prompting concerns about corrosion and the ability of pipelines to withstand stress. Frequent monitoring, corrosion control programs, and selective rehabilitation or replacement, however, can offset the effects of aging. (TRB 1988, 16–17) Performance then can be measured by output and by the number of pipeline failures, a key indicator of pipeline condition.

[6] This figure is a slight improvement from the 1993 figure of 47 percent, which was influenced by the extensive floods of that year.

In 1994, there were 222 gas pipeline incidents with 21 fatalities and 112 injuries, and 244 for liquid pipelines, with 1 fatality and an astounding 1,858 injuries caused largely from flooding in Texas. The number of incidents in 1990 was 199 for gas and 180 for oil. Pipeline incidents during the 1990s were far lower than in past decades, such as the 1,524 gas pipeline incidents in 1980 (15 fatalities) and the 246 oil pipeline incidents the same year (with 4 fatalities). (USDOT BTS 1995, 55–59)

Transportation Events in 1995

Trends in transportation can be powerfully shaped or temporarily interrupted by special events. For 1995 we identify three key transportation events. The first two events were specific to the United States: the designation of the National Highway System and changes in the industrial structure of the railroad industry. The third, the Kobe, Japan, earthquake, has no direct bearing on transportation in the United States but can be compared with the Northridge, California, earthquake of 1994, discussed in *Transportation Statistics Annual Report 1995*.

The Interstate Commerce Commission (ICC) was terminated at the end of 1995. Its railroad data programs were transferred to the Surface Transportation Board, a new Department of Transportation entity; motor carrier registration and insurance oversight were transferred to the Federal Highway Administration. Quarterly and annual reporting of financial and operating data by motor carrier was transferred to BTS.

BTS also notes the loss of 11 employees of the Oklahoma City office of the Federal Highway Administration, who were among the 168 killed in the bombing of the Alfred P. Murrah Federal Building on April 19, 1995.

► The National Highway System Designation

In 1995, Congress passed the National Highway System Designation Act (Public Law 104-59), formally establishing the National Highway System (NHS), which was first called for in the Intermodal Surface Transportation and Efficiency Act of 1991. The NHS, approximately 157,000 miles, is only 4 percent of all public roads and is composed of five parts: the Interstate highways (46,000 miles), 21 congressionally designated high-priority corridors (5,000 miles), key primary and urban arterials (89,000 miles), the non-Interstate part of the Strategic Highway Corridor Network (15,000 miles), and key Strategic Highway Corridor Network connectors (2,000 miles).

The main purpose of the NHS is to focus federal resources on the most heavily used highways and on those that link the highway system and other key elements of the transportation system, such as ports, international border crossing points, major airports, and public transportation facilities. System changes, as demanded by passenger and freight transportation needs, can be made by the Secretary of Transportation based on requests submitted by states.

► Changes in the Railroad Industry

The number of Class I railroads in the United States has been declining for decades. In 1980, there were 32 Class I railroad systems; only 10 remained at the end of 1995. Fifteen carriers were merged or consolidated with other systems. The other seven were reclassified for regulatory reporting purposes.

The Interstate Commerce Commission approved the merger of the Burlington Northern Railroad Company (Burlington Northern) and the Atchison, Topeka and Santa Fe Railway Company (Santa Fe) in August 1995. Burlington

Northern was ranked first among U.S. rail carriers in 1994, measured by miles of road and number of employees, and second in operating revenue. Santa Fe was seventh in all three categories. (AAR 1995a, 64–65) Burlington Northern operated 25,000 miles of track in the United States and Canada, and Santa Fe operated 10,400 miles in the United States. Together they are the most extensive rail property in the country.

The second consolidation approved by the Interstate Commerce Commission in 1995 was the acquisition of the Chicago and North Western Transportation Company by the Union Pacific Corporation. Union Pacific is ranked third in road miles (17,500) and employees (29,000). CNW ranked eighth in both categories. Union Pacific and CNW ranked first and eighth, respectively, in operating revenue.

► The Kobe, Japan, Earthquake and Transportation

One year to the day after the Northridge, California earthquake (on January 17, 1995) a Richter magnitude (M) 6.8 earthquake hit the port city of Kobe—located toward the southern end of Honshu, Japan's main island—killing more than 6,000 people and causing property damage of $94 billion. (Doi 1996) Officials estimated that nearly 180,000 buildings were badly damaged or destroyed and more than 300,000 of the city's 1.4 million people were made homeless by the 20 seconds of severe ground shaking. Centered just 12 miles southwest of downtown, much of the earthquake's energy passed through the most built-up part of Kobe, a three-mile-wide corridor of land between Osaka Bay to the south and the Rokko Mountains to the north.

The city's highways and railroads were very badly damaged, breaking the land connection between the southwestern part of Honshu island and the central and northeastern areas, including Tokyo. The two main limited-access highways—the Hanshin and Wangan expressways—that served the Kobe-Osaka transportation corridor were severed by the earthquake. Rail lines, including the bullet train, were also severed. The subway and local roads were damaged. Port facilities were almost completely destroyed. (EQE International 1995) Before the earthquake, Kobe was the largest container port in Japan, handling approximately 30 percent (2.7 million containers a year) of Japan's container shipping. Eight thousand containers a day had to be redirected to other ports. The long-term effects on the port are unknown. Some worry that traffic diverted may never return and that other ports such as Pusan in South Korea, Taiwan's Kaohsiung, Hong Kong, and Singapore might gain in the long run (Box 1995). About the only unscathed parts of the transportation system were the two major airports—Kansai and Itami. Repair costs for transportation facilities alone have been estimated at $60 billion.

By comparison, the 1994 Northridge earthquake on the same day in 1994, an M6.4, resulted in 57 deaths and $20 billion to $25 billion of damage. Another $6.5 billion in losses was due to business interruption, of which $1.5 billion can be ascribed to transportation-related effects. (Gordon et al 1996) The much greater devastation in Kobe resulted not from differences in engineering technology, but rather from the timing and location of the earthquakes, Kobe's generally older built environment, and Kobe's coastal location of soft alluvial soil and reclaimed land. A contributing factor to the immense damage to the transportation system was the elevation of many primary routes because of the lack of developable land. Seismologists and engineers note that the Kobe event has many implications for the United States, particularly San Francisco (another high-density port founded on alluvial soils, with relatively old building stock, and many elevated transportation routes). It has been calculated that the Hayward fault, which runs under a part of the San Francisco Bay area, including Oakland and Berkeley, could possibly generate energy of M8+. (EQE International 1995) The San Francisco earthquake of 1906 registered M8.3. Other areas, such as the Pacific Northwest, should not be complacent about the chances of a major earthquake either, even though the probability of a major earthquake there is lower than one in California. Most people expected that Tokyo would be the site of a major earthquake rather than Kobe. Possibly more frightening is that—as devastating as it was—the Kobe earthquake is considered a moderate event. Neither Kobe nor Northridge was the "big one."

In general, older structures and those not retrofitted to new building codes implemented in 1981 performed very poorly in Kobe. This includes the Hanshin Expressway built in the 1960s and old elevated railway lines. Post-1981 structures performed much better. The major exceptions to this were buildings, bridges, and other structures built on the softest soil and reclaimed land, including portions of the Wangan Expressway and the entire port. Finding ways of mitigating the effects of liquefaction, lateral spreading, and settlement in such places seems to be a high priority. (EQE International 1995) As was found after the Northridge earthquake, newer design standards can work well in moderate to large earthquakes, and retrofitting older structures is important. Kobe also points to a concern for U.S. ports on or near faults. Many ports on the west coast including the ports of Los Angeles, Long Beach, Oakland, Seattle, and Vancouver are prone to earthquake damage. Lessons from Kobe's railways also need to be studied for application to commuter rail systems and subways such as those in San Francisco and Los Angeles.

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